

Investigating the 2010 Undercount of Young Children – Analysis of Census Coverage Measurement Results

A New Design for the 21st Century

Issued January 2017

Version <1.0>

Prepared by Decennial Statistics Studies Division



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1. INTRODUCTION

The Census Bureau acknowledges the long-standing undercount of young children in decennial censuses and in Census Bureau surveys. Demographers have documented the high undercount of children under the age of 5 (e.g., West and Robinson 1999). Evaluations show that Census Bureau surveys like the American Community Survey (ACS), the Current Population Survey, and the Survey of Income and Program Participation also undercount young children, which can result in biased survey estimates (O'Hare and Jensen 2014). O'Hare (2015) found many other countries have a high net undercount of young children in their censuses.

In this report, we define “young children” as children age 0 to 4. After the 2010 Census, Demographic Analysis estimated a net undercount of about 4.6 percent for young children (Hogan et al. 2013). This translated into a net undercount of almost 1 million young children. O'Hare (2015) shows that the net undercount rates for young children increased from 1.4 percent in 1980 to 4.6 percent in 2010, while the net undercount rate for the adult population (age 18+) went from an undercount of 1.4 percent in 1980 to an overcount of 0.7 percent in 2010. The rise in the undercount of young children underscores the importance of examining this coverage problem in greater detail.

In 2014, the Census Bureau released a task force report summarizing this issue and recommending research to better understand the possible causes for this undercount (U.S. Census Bureau 2014). An interdivisional team is working on several projects to review existing data sources that might provide insights into the high undercount of young children in the 2010 Census.

The 2010 Census Coverage Measurement (CCM) program used dual system estimation to produce population estimates and to estimate coverage of the household population. The CCM program measured overcounts and undercounts across the population. A comparison of the CCM estimates to the 2010 Census showed a small undercount of children under age 5 of 0.72 percent (Mule 2012). However, there are limitations with the CCM program as a method for estimating the coverage of young children. The CCM survey occurred several months after the Census, and the CCM may also miss the same people that the 2010 Census missed (correlation bias). Despite these limitations, the CCM has the benefit of providing microdata to study situations where the census may have erroneously excluded young children.

This report examines the characteristics of young children who were enumerated in the 2010 CCM survey but did not match to a 2010 Census record. These nonmatches could represent young children that the 2010 Census excluded in error. The results provide a preliminary profile of the types of children who are most at risk of undercoverage.

2. BACKGROUND

2.1 Coverage Measurement Results - 1990

Coverage measurement surveys provide important information about net undercoverage. The sample design and estimation methods permit the production of estimates by geography, tenure, race, Hispanic origin, age, and sex. The 1990 Post Enumeration Survey (PES) design gave relatively low priority to undercount estimates by age and sex. Rather, key summary results highlight net undercoverage estimates by tenure, race, Hispanic origin, and geography (Hogan 1993). West and Robinson (1999) used 1990 PES data to estimate the net undercoverage of children age 0 to 17 (the only age breakout possible). They found a higher undercount of children in American Indian, Hispanic, and Black households than those in White households. They also documented that the 1990 Census undercounted children in renter households by a higher percentage than those in owner households. This finding held for all race/ethnicity groups except Black, for which the difference was not statistically significant. Table 1 summarizes selected estimates from their research, comparing percent net undercoverage estimates for children to net undercoverage estimates for the total population. Without exception, the net undercoverage estimates for children were greater than, or not significantly different from, those for the total population. In the table, a negative estimate denotes a net overcount.

Table 1. Comparison of Percent Undercount for Selected Post-Strata: Children 0-17 and Total Population – 1990 PES

Post-Stratum	Children 0-17 Percent Net Undercount and SE	Total Population Percent Net Undercount and SE
Non-Hispanic White & Other	2.0 (0.32)	0.7 (0.22)
Owner	1.2 (0.36)	-0.3 (0.23)
Renter	4.0 (0.67)	3.1 (0.50)
Black	7.1 (0.87)	4.6 (0.53)
Owner	5.6 (1.16)	2.3 (0.56)
Renter	8.1 (1.16)	6.5 (0.82)
Non-Black Hispanic	4.9 (0.95)	5.0 (0.77)
Owner	1.2 (1.16)	1.8 (0.67)
Renter	7.5 (1.33)	7.4 (1.18)
Asian and Pacific Islander	3.3 (2.09)	2.4 (1.36)
Owner	-0.5 (2.55)	-1.5 (1.50)
Renter	8.0 (3.54)	7.0 (2.52)
American Indians on Reservations	13.8 (5.00)	12.2 (4.73)

Source: West and Robinson 1999

SE: Standard Error

A positive estimate denotes a net undercount and a negative estimate denotes a net overcount.

West and Robinson (1999) also produced net undercoverage estimates for children by urbanization. They found that when they considered location of the rental unit, Hispanic children in renter occupied units in rural areas had significantly higher net undercoverage rates than their counterparts in urban areas. For non-Hispanic White and Black children living in rental units, urbanization was not a factor. Similarly, among owners there was no pattern by degree of urbanization.

The 1990 PES used dual system estimation to measure net coverage of the 1990 Census. The first system was a sample of census enumerations. This sample was used to measure erroneous enumerations, such as duplicate enumerations. The second system was an independent listing and enumeration of a sample of the population that was matched to the census. See Hogan (1993) for details on the methods used in the 1990 PES. While the goal was the production of net undercount estimates, we can use the nonmatches from the independent enumeration to study census error. In particular, we can look at types of census nonmatches to understand possible reasons for undercoverage. Hogan (1993) defined the following five categories of census nonmatches:

1. Nonmatched person within a household where other people matched (within household).
2. Nonmatched person within a household where no other person matched; however, the housing unit was included in the census (whole household).
3. Nonmatched person within a missed housing unit; however, other housing units in the building were included in the census (housing unit – unit only).
4. Nonmatched person living in a building missed by the census (housing unit – structure).
5. Nonmatched person because of a Census Bureau processing error (processing error).

He found that the 1990 PES nonmatches included a high proportion of within-household nonmatches. West and Robinson (1999) used these data to estimate the distribution of all nonmatches. Table 2 summarizes their findings. The 1990 nonmatches were fairly evenly distributed across the three major types—within household, whole household, and whole housing unit errors. It is important to acknowledge that these distributions have limitations. Namely, a nonmatch does not necessarily imply a census omission. Reasons why a person may not match to the census include:

1. The person was missed by the census (i.e., a true omission).
2. The person was included in the census, but the census record did not have sufficient characteristic information for accurate matching. Usually, a census record does not have sufficient information for matching because it is missing a valid name.
3. The person was included in the census, but in the wrong location.

Table 2. Distribution of Types of Nonmatches - 1990 PES

Type of Nonmatch	Percent of Total Resolved Cases	Percent of All Nonmatches
Within household nonmatch	1.8	30.5
Whole household nonmatch	2.0	33.9
Housing unit nonmatch – unit only	0.5	8.5
Housing unit nonmatch – structure	1.3	22.0
Processing error	0.3	5.1
Total Nonmatches	5.9	100.0

Source: West and Robinson 1999; Hogan 1993

2.2 Coverage Measurement Results – 2000

The Accuracy and Coverage Evaluation (ACE) measured net coverage in Census 2000. Using methods similar to those used in past coverage measurement surveys, the ACE produced net undercount estimates for five age categories: 0-9, 10-17, 18-29, 30-49, and 50+. The estimated net coverage for children age 0 to 9 was a 0.46 percent net overcount with a standard error of 0.33

percent, (Fenstermaker 2002). This estimate was not significantly different from zero. Table 3 summarizes additional results for children. A negative value indicates a net overcount. Unlike the 1990 PES estimates of coverage for children under 18, the 2000 ACE found no evidence that the census undercounted children.

Table 3. A.C.E. Estimates of Percent Net Undercount by Race, Sex, and Age - Census 2000

Category	Male	Female
Black 0-9	0.72	0.70
Non-Black 0-9	-0.68	-0.68
Black 10-17	-0.59	-0.55
Non-Black 10-17	-1.46	-1.44

Source: Robinson and Adlakha 2002

Note: Source did not provide standard errors for these estimates.

A positive estimate denotes a net undercount and a negative estimate denotes a net overcount.

A comparison of ACE Revision II results with Demographic Analysis (DA) found that the ACE estimates for children age 0 to 9 were much lower than the DA estimates for young children (Robinson and Adlakha 2002). Note that this is not a statistical comparison because standard errors were not provided for the ACE Revision II estimates and the DA estimates are not subject to sampling error. DA found that children age 0 to 9 were the only group that showed a noteworthy undercount rate in 2000 for both Blacks and non-Blacks (between 2.2 and 3.6 percent) (Robinson and Adlakha 2002). Correlation bias is a likely explanation for the stark difference between the ACE and DA estimates for young children. While the 2000 ACE Revision II included an adjustment for correlation bias for adult males, the Census Bureau did not make any adjustments for children under 18.

2.3 Coverage Measurement Methodology and Design - 2010

The primary purposes of the 2010 CCM were to evaluate coverage in the 2010 Census and to identify areas warranting attention in planning for the 2020 Census. The Census Bureau designed the program to measure the coverage of housing units and population, intentionally excluding Group Quarters facilities and the people living in them. The 2010 CCM produced estimates of net coverage and components of census coverage (correct enumerations, erroneous enumerations, whole-person census imputations, and omissions). Moldoff (2008) provides an overview of the 2010 CCM.

The CCM sample was an area-based sample comprising block clusters in each state, the District of Columbia, and Puerto Rico. The Population sample (P sample) and the Enumeration sample (E sample) were the two samples used for dual system estimation. CCM listers independently listed all housing units in the sample block clusters in an operation called the Independent Listing. This listing became the housing unit frame for the P sample. Independent from the census, the CCM person interview enumerated everyone living in P-sample housing units. The E sample comprises the census housing units and person enumerations in the same block clusters as the P sample.

Census interviewers conducted CCM person interviewing between August and October 2010. The goals were to create a roster and to collect information about the residents of the sample housing units at the time of the CCM interview. This included both nonmovers and inmovers. Nonmovers

are people who lived in the housing unit on Census Day (April 1, 2010) and at the time of the CCM interview. Inmovers are people who had moved into the sample housing unit since Census Day. The person interview also collected information about people who had moved out of the sample housing unit between Census Day and the CCM interview date (outmovers). CCM interviewers used laptops and computer-assisted instruments to collect this information in person and by phone. The overall response rate of the CCM Person Interview was 98.4 percent (Linse and Argarin 2012).

To identify which individuals the census correctly enumerated, erroneously enumerated, or omitted, CCM matched people enumerated by the CCM person interview operation to people enumerated by the census. The search area for a match was the block cluster where the person should have been counted in the census as well as the ring of surrounding blocks. This matching operation included both computer and clerical components. Interviewers conducted a field followup whenever a match, residence, duplicate, or enumeration status was unresolved. These matching and followup operations resulted in the assignment of a set of final residence and match codes for all P-sample people and housing units. After the completion of all matching and followup activities, 2.4 percent of the person records in the P sample had an unresolved residence status (Johnson et al. 2012). That is, it could not be determined whether the person was a nonmover, inmover, or out of scope. Less than 1 percent of the P-sample person records and the P-sample housing units did not have a resolved match status (Johnson et al. 2012; Contreras et al. 2012). If a residence or match status was unresolved after all followup attempts, the CCM used statistical techniques to handle the missing data by imputing a residence or match probability.

2.4 Coverage Measurement Results – 2010

The 2010 CCM produced separate estimates for children age 0 to 4, 5 to 9, and 10 to 17. Table 4 summarizes net coverage estimates by age. A positive estimate denotes a net undercount and a negative estimate denotes a net overcount. The 2010 CCM measured a small net undercount for the youngest children only. This net undercount estimate is much smaller than the 4.6 percent net undercount estimate from Demographic Analysis. This comparison takes into account the standard error of the CCM estimate; the Demographic Analysis estimate does not have an associated standard error because it is not subject to sampling variability. As mentioned previously, the CCM survey may also miss young children. This would lead to an underestimate of the true net undercount, a phenomenon known as correlation bias.

Table 4. Net Coverage by Age - 2010 Census

Age group	Percent Net Undercount	Standard Error
0 to 4	0.72*	0.40
5 to 9	-0.33	0.31
10 to 17	-0.97*	0.29

Source: Mule 2012

*Estimate is significantly different from zero.

A positive estimate denotes a net undercount and a negative estimate denotes a net overcount.

3. RESEARCH QUESTIONS

This report answers the following research questions.

1. What are the demographic characteristics of the P-sample young children that we could not match to the 2010 Census?
2. What are the household and housing characteristics of the P-sample young children that we could not match to the 2010 Census?
3. Were the P-sample young children that we could not match to the 2010 Census nonmatches because of potential frame errors? Were they nonmatches along with other household members?
4. What is the census mode of enumeration for housing units with a young child that we could not match to the 2010 Census?
5. Which demographic, housing, and household characteristics had the highest nonmatch rates for young children? Which modes of enumeration have the highest nonmatch rates?

4. METHODOLOGY

4.1 Sources and Definitions

The CCM survey created a roster of people for the household that existed at the time of the CCM interview. CCM assigned residence status codes based on where a person lived on Census Day (April 1) and the CCM interview day. For our analysis, we consider only resolved nonmovers and in-movers in the P sample. Nonmovers are persons who lived in the same unit on both Census Day and the CCM interview day. In-movers are persons who lived in the sample unit on the CCM interview day, but lived in a different unit on Census Day. For a small portion of cases, the CCM could not determine the residence status of a person or whether the person should be included in the P sample; such cases were omitted from this research.

The CCM attempted to match all people in the P sample to where they were living on Census Day. For nonmovers, the search area was the sample block cluster and the ring of surrounding blocks. For in-movers, the search area was based on the information provided about the Census Day residence. If the Census Day residence could be narrowed down to a single address, single block, or a few contiguous blocks, then the search area for the in-mover included these blocks and the ring of surrounding blocks. If the Census Day residence was not specific (e.g., only a city or county was provided), then these in-movers were assigned an unresolved match status.

We identified all instances where a young child in the CCM survey did not match a person record in the 2010 Census. To identify these nonmatches, we used the final CCM match probability, including imputations for unresolved cases. CCM assigned resolved matches and nonmatches a value of 1 and 0, respectively. For people with an unresolved match status, the CCM imputed a match probability. After adjusting the final match codes to comply with the definitions for estimating net census error, about 3 percent of the total P-sample person records had an unresolved match status (Viedorfer et al. 2012).

We report weighted results using the final match weight, which includes a noninterview adjustment. Research questions 1 and 2 are summaries of the children nonmatches by characteristics of the children and the housing units and households in which they lived. We used the final assigned characteristics, which include edits and imputations for missing data.

Answering research question 3 required that we distinguish between children nonmatches in housing units that matched versus those housing units that did not. It also required determining the match status of other people in the P-sample household. Because we were interested in the match status of the housing unit and the other household members, we limited the analysis to the P-sample households that contained only nonmovers. This is similar to the approach taken to analyze nonmatches in Hogan (1993). About 76 percent of the nonmatching young children were nonmovers (see Table 6). It is important to note that the CCM survey conducted matching within a broader search area than the individual housing unit. It is possible that a person may match to the census even though that person's P-sample housing unit did not match to the census.

To determine the household match status, we considered the other people in the unit as nonmatches if they were either a resolved nonmatch or had an unresolved match status. Similarly, we considered a P-sample housing unit a nonmatch if the housing unit was a resolved nonmatch or had an unresolved match status. The three categories of household match status are:

1. Whole-household nonmatch: All people in the P-sample household are nonmatches.
2. Partial-household nonmatch: Some people in the P-sample household other than the young children are nonmatches (i.e., at least one person age 5+ is a nonmatch).
3. Young children only nonmatches: Only the young children are nonmatches.

Research question 4 seeks to determine how the error occurred. Specifically, it attempts to identify the mode of census enumeration associated with the housing unit where the census should have counted the nonmatched child. It is difficult to assign a nonmatched person to a specific census housing unit. If the nonmatched child is in a P-sample housing unit that matched to a census housing unit, then we can look at the enumeration mode for that housing unit, with the limitation that this is not necessarily the correct census housing unit for us to identify with the nonmatching child. If the nonmatched child is in a P-sample housing unit that did not match, then we cannot make any statements about the mode of enumeration for these cases.

Research question 5 involves nonmatch rates. We defined these rates as the proportion of all P-sample young children with a given characteristic that were nonmatches. As noted earlier, nonmatches include true census omissions, cases with insufficient data for matching, and cases where the census counted the person in the wrong area. Collectively, the nonmatches represent young children with enumeration challenges and potential coverage implications.

4.2 Weighting and Estimation

The P sample is an area-based cluster sample of census block clusters. A block cluster is made up of one or more contiguous census collection blocks and averages about 30 housing units. The weighted estimates in this report use the survey weight that includes a noninterview adjustment (in which the weight for noninterviewed housing units was allocated to interviewed housing units

with similar characteristics). For young children with an unresolved match status, we used the imputed match probability from the P-sample file. These records contribute a fraction of their weight to the estimate of nonmatches. Standard errors were calculated using Taylor Series linearization, reflecting the clustered sample design, via the SAS SURVEY procedures.

4.3 Limitations

The CCM survey underestimates the undercount of young children when compared to the estimate from DA. DA is widely believed to provide the best estimates of net coverage of young children because of the accuracy and completeness of birth registration in the United States. The likely explanation for the difference between the CCM and DA estimates of the net undercount for young children is that the CCM survey also misses young children. This is reasonable because the CCM survey, although it is independent of the census, follows similar procedures for listing housing units and enumerating the population as the census process. The characteristics of the young children who tend to be missed by both the census and the CCM survey may differ in important ways from the nonmatches analyzed in this report. Despite this limitation, the individual-level data provided by the CCM survey are important to understanding the types of young children who are more at risk of coverage errors. The young children who are found in the CCM but do not match to the census are probably more similar to the young children missed by both systems than the young children found in both systems.

As noted earlier, a nonmatch does not necessarily imply that a person was missed in the census. The concept of the nonmatch is a specific definition needed for producing net error estimates by dual system estimation. For example, about 2 percent of people enumerated in housing units in the 2010 Census were whole-person census imputations (i.e., all characteristics were imputed for these people), but the majority of these were in housing units where the population count was known (Mule 2012). These people cannot match to a P-sample person, but they were not missed from the census. Instead of thinking of nonmatches as census omissions, we can view nonmatches as indications that the census was not complete and accurate. This will further our understanding of the types of young children that the census has difficulty enumerating.

Analyses that associate a P-sample young child with a specific census housing unit, based on the match status of the P-sample housing unit of the child, must be interpreted with caution. The CCM matching procedures do not require that a person be matched to the same census housing unit to which the P-sample housing unit matches. Rather, a broader search area is used. Furthermore, a P-sample person may match to the census even if the P-sample housing unit does not match. While these analyses may point to possible explanations of what happened at the census housing unit to result in a nonmatch, we cannot make conclusions about the relative contributions of each type of error to the undercount of young children.

Inmovers pose a further limitation. For inmovers, the CCM survey attempted to obtain the address at which the inmover lived on census day. This was not always successful. The CCM survey may have only obtained a general geographic area to search for the inmover. For these cases, we do not know the specific housing unit where the Census should have counted the nonmatched inmover.

Even if the CCM obtained a specific address, this is not necessarily the unit where the census should have counted the nonmatched child.

The characteristics of the young children and their households are as observed at the time of the CCM interview (the exception is age, which is determined as of April 1, 2010). These characteristics may differ between the time of the CCM interview and Census Day. For example, the parents of a young child may separate between the two time points, resulting in the child living with both parents during the time of the census, but with only one parent during the CCM interview. For in-movers, the characteristics of the household may differ if the whole household did not move together. We do not anticipate that such changes in the characteristics of the young children between the two time points will have a large impact on the analyses.

For some characteristics, we needed to analyze only a subset of the P-sample young children. For characteristics of the household (e.g., family type and household size), these could not be easily ascertained when the P-sample housing unit contained a mixture of in-movers and out-movers. Some characteristics of the housing unit, namely type of unit and tenure, are only analyzed for non-movers. To analyze the mode of the census enumeration, we needed to restrict the analysis to those young children associated with a specific census housing unit. For non-movers, this meant that the P-sample housing unit had to match to a census housing unit. For in-movers, this meant that we needed to know the specific housing unit in which the person was living on Census Day.

5. RESULTS

5.1 Demographic Characteristics

What are the demographic characteristics of the P-sample young children that we could not match to the 2010 Census?

The CCM was unable to match 3,058 P-sample young children to a person record in the 2010 Census. Table 5 summarizes the demographic characteristics of those 3,058 young children. The table includes the unweighted number of nonmatched P-sample young children, the weighted distributions, and the standard errors associated with the distributions. These nonmatches could represent real omissions, instances where the census record did not include sufficient information for matching, or instances where the census record was located outside of the search area. The results describe the distribution of the nonmatches, not necessarily the characteristics with the highest rates of nonmatches (see section 5.5 for the nonmatch rates).

Table 5. Demographic Characteristics of Nonmatched Young Children - 2010 CCM

	Number of Nonmatched P-Sample Young Children	Percent of all Nonmatched P-Sample Young Children	
	Unweighted Estimate	Weighted Estimate	Standard Error
Relationship to Person 1	3,058	100.0	
Biological child	2,124	72.3	1.2
Adopted child	28	0.8	0.2
Stepchild	55	1.8	0.3
Grandchild	553	15.9	1.0
Other relative	191	5.9	0.6
Foster child or other unrelated child	107	3.5	0.4
Age	3,058	100.0	
0	663	20.8	0.8
1	626	20.3	0.9
2	597	19.4	0.8
3	582	19.8	0.9
4	590	19.7	0.9
Race	3,058	100.0	
White	1,448	54.1	1.6
Black	564	20.4	1.3
American Indian & Alaska Native	287	1.8	0.3
Asian	124	4.0	0.8
Native Hawaiian & Other Pacific Islander	40	0.4	0.2
Some Other Race	364	12.7	1.0
Two or More Races	231	6.5	0.6
Hispanic Origin	3,058	100.0	
Hispanic	928	30.0	1.4
Non-Hispanic	2,130	70.0	1.4
Sex	3,058	100.0	
Male	1546	50.7	1.1
Female	1512	49.3	1.1

Source: 2010 Census Coverage Measurement – Special Tabulation

The majority of nonmatches were biological children of the householder (72 percent). Grandchildren of the householder accounted for nearly 16 percent of the nonmatched young children. We see an even distribution across specific ages and sex. The distributions by race and Hispanic origin reflect the general population distributions with White and non-Hispanic children accounting for the majority of nonmatches.

5.2 Household and Housing Characteristics

What are the household and housing characteristics of the P-sample young children that we could not match to the 2010 Census?

Table 6 includes housing unit characteristics associated with these 3,058 nonmatched young children. Like Table 5, it displays the unweighted number of P-sample young children that were nonmatches, the distribution value, and the standard error associated with each proportion. The CCM P-sample interview is the source of these housing unit characteristics. As noted earlier, nonmatches include the combination of true census omissions and records with insufficient information for matching. The vast majority of nonmatches were in Mailout/Mailback areas (92 percent) and in Metropolitan Statistical Areas (88 percent). These results also reflect general population distributions.

About 75 percent of the nonmatched children were nonmovers, meaning that the young child lived in the same housing unit on Census Day and at the time of the CCM interview. Most of these young children were in households with no in-movers, meaning that nobody moved into the housing unit between Census Day and the time of the CCM interview. The remaining 25 percent of the young children nonmatches were in-movers. Most of these in-mover nonmatches were in instances where the whole household was made up of in-movers (19.4 percent of the total nonmatches).

We restricted our analysis of type of housing unit and tenure to the 2,253 P-sample nonmatches for nonmovers. These are characteristics of the housing unit and are only available for nonmovers. About 66 percent of the nonmover young children that we could not match were in single-family homes; about 55 percent were in renter households.

Table 6. Characteristics of Housing Units with Nonmatched Young Children - 2010 CCM

	Number of Nonmatched P-Sample Young Children	Percent of all Nonmatched P-Sample Young Children	
	Unweighted Estimate	Weighted Estimate	Standard Error
Type of Enumeration Area	3,058	100.0	
Mailout/Mailback	2,514	91.6	1.0
Update/Leave	267	7.7	1.0
Update/Enumerate	277	0.7	0.1
Urbanicity	3,058	100.0	
In Metropolitan Statistical Areas	2,488	87.8	
Large	928	34.4	1.8
Medium	1,075	38.5	1.8
Small	485	14.9	1.2
Outside Metropolitan Statistical Areas	570	12.2	1.1
Mover Status	3,058	100.0	
In-mover	805	24.4	1.2
Whole household of in-movers	613	19.4	1.1
Nonmovers in household	192	4.9	0.6
Non-mover	2,253	75.7	1.2
No in-movers in household	2,164	73.2	1.3
In-movers in household	89	2.4	0.4
Type of Unit (Nonmovers only)	2,253	100.0	
Single Unit	1,396	66.2	1.8
Small Multiunit	376	14.6	1.3
Large Multiunit	222	9.8	1.1
Other	259	9.4	1.1
Tenure (Nonmovers only)	2,253	100.0	
Owner	982	45.3	1.9
Renter	1,271	54.7	1.9

Source: 2010 Census Coverage Measurement – Special Tabulation

Table 7 summarizes the household characteristics of nonmatched young children. We could only produce these results for P-sample households with available household characteristics. These are households that did not contain both in-movers and out-movers. A total of 2,975 nonmatched young children had sufficient household information for this summary (98 percent of the 3,058 total nonmatched young children). Recall that these characteristics reflect the household as it existed at the time of the CCM interview. About half of all nonmatched young children lived in three or four-person households. The household type summaries show that related households, specifically husband-wife families, account for the largest proportions of nonmatches. Related households are

households where all people are relatives of the householder. About 22 percent of nonmatched young children were living in nonrelated households. We defined complex households as all households other than 1) a single-parent householder with biological or adopted children or 2) a married-couple household with biological or adopted children. About 48 percent of the nonmatched young children were living in complex households.

The distribution by age of the householder shows that about half of the nonmatched young children were living with a householder age 30 to 49. Another 40 percent were living with young householders, age 18 to 29. The distributions by race and Hispanic origin of the householder are similar to those characteristics of the nonmatched children themselves, as seen in Table 5.

Table 7. Characteristics of Households with Nonmatched Young Children - 2010 CCM

	Number of Nonmatched P-Sample Young Children	Percent of all Nonmatched P- Sample Young Children	
	Unweighted Estimate	Weighted Estimate	Standard Error
Household Size	2,975	100.0	
2-person household	189	6.5	0.6
3-person household	637	23.0	1.0
4-person household	784	27.9	1.3
5-person household	597	20.2	1.1
6-person household	326	10.4	0.8
7-or-more-person household	442	12.1	1.0
Household Type	2,975	100.0	
Related households	2,317	78.4	1.1
Male householder	1,014	36.1	1.4
Female householder	1,303	42.3	1.4
Nonrelated households	658	21.6	1.1
Male householder	328	10.3	0.8
Female householder	330	11.3	0.9
Related Household Type	2,975	100.0	
Related household	2,317	78.4	1.1
Husband-wife present	1,358	48.3	1.5
Female householder, no husband present	828	25.5	1.3
Male householder, no wife present	131	4.7	0.5
Nonrelated household	658	21.6	1.1
Complex Household	2,975	100.0	
Complex	1504	47.7	1.5
Not complex	1471	52.3	1.5
Age of householder	2,975	100.0	
15-29	1,171	39.3	1.5
30-49	1,417	49.5	1.5
50+	387	11.2	0.9
Race of householder	2,975	100.0	
White	1,489	57.3	1.6
Black	565	20.8	1.3
American Indian & Alaska Native	285	1.6	0.3
Asian	127	4.3	0.8
Native Hawaiian & Other Pacific Islander	52	0.4	0.1
Some Other Race	370	13.1	1.0
Two or More Races	87	2.4	0.4
Hispanic Origin of Householder	2,975	100.0	
Hispanic	808	27.6	1.4
Non-Hispanic	2,167	72.4	1.4

Source: 2010 Census Coverage Measurement – Special Tabulation

5.3 Type of Nonmatch

Were the P-sample young children that we could not match to the 2010 Census nonmatches because of potential frame errors? Were they nonmatches along with other household members?

Table 8 summarizes the match status of the housing unit and of other people living with the young children nonmatches. We included 2,081 nonmatched young children in this analysis. These nonmatches correspond to young children in a household where all the people were nonmovers. Units with in-movers are excluded since the in-movers were not part of the household on Census Day. Additionally, a few units that contained out-movers were excluded for ease of analysis. This is why the 2,081 young children nonmatches in this analysis is slightly lower than the 2,164 nonmatches for nonmovers in units without in-movers from Table 6.

About 16 percent of the nonmatched children were in a housing unit that was also a nonmatch. This suggests that frame errors (i.e., missed housing units) may contribute to the undercount of young children.

Of particular interest is the finding that about 16 percent of the nonmatched young children were instances where the child was the only nonmatch. About 46 percent of the nonmatched children were in a household where the entire household was a nonmatch. An additional 22 percent of nonmatched young children were nonmatches in a household with at least one other nonmatch. Recall that a nonmatch does not necessarily imply a census omission. A nonmatch may occur because the census record corresponding to P-sample person did not have sufficient information for matching. This scenario may explain many of the whole-household and partial-household nonmatches. For example, a proxy respondent may have been able to provide a population count and limited demographic information for a household, but not the names of the occupants. In this instance, the CCM would not have been able to match to these census people, resulting in a whole-household of nonmatches. Because of these limitations, we cannot readily use these results to conclude the extent to which the undercount of young children is due to whole-household omissions as opposed to within household omissions. Rather, these results indicate that a variety of error sources are possible.

Table 8. Distribution of Types of Nonmatches - 2010 CCM

	Number of Nonmatched P-Sample Young Children	Percent of all Nonmatched P-Sample Young Children	
	Unweighted Estimate	Weighted Estimate	Standard Error
Nonmover	2,081	100.0	
Housing Unit Nonmatch	351	15.5	1.6
Housing Unit Match	1,730	84.4	1.6
Child only nonmatch	351	16.2	1.1
Child and other (but not all) nonmatch (partial household)	465	22.2	1.4
Child and entire household nonmatch (whole household)	914	46.0	1.8

Source: 2010 Census Coverage Measurement – Special Tabulation

5.4 Mode of Enumeration

What is the census mode of enumeration for housing units with a young child that we could not match to the 2010 Census?

Table 9 summarizes the distribution of nonmatches by mode of enumeration and mover status. We used a total of 2,278 nonmatches in this summary—all of the nonmatches that were in housing units that matched. Since mode of enumeration is a census variable, we could only analyze the young children in P-sample housing units that were matched to a census housing unit. A total of 1,869 nonmatches were associated with nonmover households; an additional 409 nonmatches are in mover households. For in-movers, we could only analyze those young children for which the CCM survey obtained the Census Day housing unit. Often, only the general area where an in-mover lived on Census Day was known, hence only 409 of the 805 in-mover nonmatches could be analyzed here. We present the results separately by mover status. Mode of enumeration includes self response and three Nonresponse Followup (NRFU) categories: NRFU – household respondent, NRFU – proxy respondent, and NRFU – vacant/delete (i.e., units that were not occupied in the census). Because of small sample sizes, the Update/Enumerate mode is included with NRFU – household respondent. Update/Enumerate is like NRFU in that a census enumerator conducted an in-person interview with the household.

As discussed in the Limitations section, the CCM did not require that a person be matched to the same census housing unit to which the P-sample housing unit was matched. Differences in the CCM and census housing unit lists as well as errors in the housing unit matching could lead us to associate a nonmatched P-sample young child with an incorrect census housing unit. Furthermore, the census may have enumerated a completely different household at the address than the CCM enumerated. Therefore, the results of this section must be interpreted cautiously. The distributions of the nonmatches provide indications of the types of errors that may have occurred, not perfect estimates of the relative contributions of these errors.

For nonmover young children, 31 percent of the nonmatches were associated with a census housing unit that self-responded to the census. NRFU accounted for nearly all of the other nonmatches with NRFU proxy respondents accounting for 29 percent and NRFU household respondents accounting for another 28 percent. We found about 11 percent of the nonmatched nonmover young children were associated with a census address that was classified as vacant or delete. Delete refers to an address that a Census enumerator determined not to be a housing unit (e.g., a business address, demolished unit, or a unit that was under construction on Census Day).

We see similar results for in-mover households. Self response was the mode of enumeration for about 29 percent of the in-mover nonmatched children. NRFU proxies accounted for another 28 percent while NRFU household respondents represented 25 percent of the in-mover nonmatches. The final 18 percent of this distribution were in-mover nonmatches that were associated with a housing unit that a census enumerator determined to be vacant or a delete.

Table 9. Distribution of Nonmatches by Mode of Enumeration and Mover Status

	Number of Nonmatched P-Sample Young Children Unweighted Estimate	Percent of all Nonmatched P-Sample Young Children Weighted Estimate	Standard Error
Nonmover	1,869	100.0	
Self-response	530	31.2	1.6
NRFU – Household respondent and Update/Enumerate	626	28.2	1.6
NRFU – Proxy respondent, occupied	491	29.4	1.6
NRFU – Vacant/delete	222	11.2	1.1
Inmover	409	100.0	
Self-response	117	29.1	3.0
NRFU – Household respondent and Update/Enumerate	109	25.2	2.9
NRFU – Proxy respondent, occupied	113	28.1	3.3
NRFU – Vacant/delete	70	17.6	2.9

Source: 2010 Census Coverage Measurement – Special Tabulation

5.5 Comparison of Nonmatch Rates

Which demographic, housing, and household characteristics had the highest nonmatch rates for young children?

Tables 10, 11, and 12 use the characteristics from Tables 5 through 7 and display nonmatch rates and their associated standard errors. We define the nonmatch rate as the ratio of P-sample young children that we were unable to match to the universe of all young children in the P-Sample. Unlike the earlier distributions, the nonmatch rates account for the universe and therefore show the categories with the greatest proportion of their universe being nonmatches. Recall that nonmatches are not necessarily census omissions, but also include situations where the census record had insufficient information or was counted in the wrong location. Regardless of the reason for the nonmatch, characteristics with high nonmatch rates can be interpreted as types of young children that the census had difficulty enumerating completely and accurately.

Table 10 displays nonmatch rates for the demographic characteristics of the young child. Here we see that stepchildren, grandchildren, other relatives, and unrelated children each have a higher nonmatch rate than biological children. This indicates that the census has more difficulty enumerating children with these relationships to the householder. The nonmatch rates by age are very similar. Young children reporting a race of Black, American Indian or Alaska Native, Some Other Race, or two or more races each have a higher observed nonmatch rate than White young children. The nonmatch rate for Hispanic children is higher than the nonmatch rate for non-Hispanic children. We do not see a difference in the nonmatch rate by sex.

Table 10. Nonmatch Rates – Demographic Characteristics

	Nonmatch Rate	
	Weighted Estimate	Standard Error
Relationship to Person 1	11.1	0.3
Biological child	9.8	0.3
Adopted child	6.8	1.8
Stepchild	17.9	3.0
Grandchild	15.6	0.9
Other relative	22.1	2.0
Foster child or other unrelated child	24.5	2.7
Age	11.1	0.3
0	12.1	0.6
1	11.5	0.6
2	10.6	0.5
3	10.6	0.6
4	10.6	0.5
Race	11.1	0.3
White	9.1	0.3
Black	17.2	1.1
American Indian & Alaska Native	16.3	2.6
Asian	10.0	1.2
Native Hawaiian & Other Pacific Islander	18.6	5.8
Some Other Race	14.7	1.0
Two or More Races	12.9	1.2
Hispanic Origin	11.1	0.3
Hispanic	13.1	0.6
Non-Hispanic	10.4	0.4
Sex	11.1	0.3
Male	11.1	0.4
Female	11.0	0.4

Source: 2010 Census Coverage Measurement – Special Tabulation

The nonmatch rates for housing characteristics in Table 11 are similar within type of enumeration area and urbanicity. These results do not point to large metropolitan areas as having the greatest potential problem with enumerating young children. We see important differences by tenure, type of unit, and mover status. Young children living in renter-occupied housing units had a higher nonmatch rate than children living in owner-occupied housing units. Young children living in small multiunits and other types of units (e.g., trailers) had higher nonmatch rates than those living in single units. Children who were in-movers had a higher nonmatch rate than non-mover children. This held if everyone in the P-sample household was an in-mover and when there were some non-movers in the household. This result demonstrates the difficulty in successfully enumerating people who move during the time of the census data collection. Children who were non-movers living in a household with some in-movers had a higher nonmatch rate than non-mover children in households where everyone was a non-mover. This result suggests that households with fluid membership are difficult to enumerate, even for those people who remained static members of the household.

Table 11. Nonmatch Rates - Housing Characteristics

	Nonmatch Rate	
	Weighted Estimate	Standard Error
Type of Enumeration Area	11.1	0.3
Mailout/mailback	11.0	0.3
Update/leave	12.1	1.3
Update/enumerate	12.8	2.6
Urbanicity	11.1	0.3
In Metropolitan Statistical Areas	11.0	0.3
Large	10.6	0.5
Medium	11.2	0.5
Small	11.8	0.9
Outside Metropolitan Statistical Areas	11.1	0.9
Mover Status	11.1	0.3
Inmover	23.2	1.1
Whole household of inmovers	22.5	1.2
Nonmovers in household	26.3	2.5
Nonmover	9.5	0.3
No inmovers in household	9.4	0.3
Inmovers in household	14.6	2.1
Type of Unit (Nonmovers only)	9.5	0.3
Single Unit	8.2	0.3
Small Multiunit	14.0	1.1
Large Multiunit	11.4	1.1
Other	14.7	1.5
Tenure (Nonmovers only)	9.5	0.3
Owner	7.1	0.4
Renter	12.9	0.6

Source: 2010 Census Coverage Measurement – Special Tabulation

Table 12 shows the nonmatch rates for characteristics of the household. Recall from Table 7 that some young children were dropped from this analysis because the characteristics of the household were not available. The nonmatch rate for the subset of young children in this analysis is similar to the overall nonmatch rate for young children (11.0 versus 11.1 percent, respectively).

Table 12 indicates that young children in two-person households have a significantly higher nonmatch rate (19.3 percent) than other size households. These are households where the child lived with a single adult. Nonrelated households (i.e., households with a least one person who is not a relative of the householder) have a higher nonmatch rate than related households (15.5 versus 10.2 percent, respectively). Among related households, young children had higher nonmatch rates when there was not a spouse of the householder as compared to husband-wife households. We also see a higher nonmatch rate for young children living in complex households than non-complex households.

The nonmatch rates for children living with householders age 15 to 29 and 50+ are each greater than the nonmatch rate for young children living with householders age 30 to 49. The oldest householders may be the grandparents of the young children. Recall that we observed higher nonmatch rates for grandchildren than biological or adopted children. The nonmatch rates by the race and Hispanic origin of the householder are similar to those for these characteristics of the young children themselves.

Table 12. Nonmatch Rates - Household Characteristics

	Nonmatch Rate	
	Weighted Estimate	Standard Error
Household Size	11.0	0.3
2-person household	19.3	1.5
3-person household	11.9	0.5
4-person household	9.3	0.5
5-person household	10.5	0.6
6-person household	10.7	0.9
7-or-more-person household	12.5	1.0
Household Type	11.0	0.3
Related households	10.2	0.3
Male householder	8.7	0.4
Female householder	11.9	0.5
Nonrelated households	15.5	0.8
Male householder	15.0	1.1
Female householder	16.0	1.2
Family Type	11.0	0.3
Related households	10.2	0.3
Husband-wife present	8.0	0.3
Female householder, no husband present	17.2	0.9
Male householder, no wife present	20.6	2.2
Nonrelated household	15.5	0.8
Complex Household?	11.0	0.3
Yes	14.1	0.5
No	9.1	0.4
Age of householder	11.0	0.3
15-29	14.4	0.6
30-49	8.9	0.4
50+	13.8	1.0
Race of householder	11.0	0.3
White	9.1	0.3
Black	17.0	1.1
American Indian & Alaska Native	16.1	2.7
Asian	9.8	1.2
Native Hawaiian & Other Pacific Islander	13.3	3.5
Some Other Race	15.0	1.0
Two or More Races	14.4	2.1
Hispanic Origin of Householder	11.0	0.3
Hispanic	13.3	0.7
Non-Hispanic	10.3	0.4

Source: 2010 Census Coverage Measurement – Special Tabulation

Which modes of enumeration have the highest nonmatch rates?

Table 13 converts the data in Table 9 into nonmatch rates, using the mode of enumeration for all P-sample young children as the denominator. We present results separately for nonmovers and in-movers. We see very high nonmatch rates for young children associated with households enumerated as occupied during NRFU by a proxy (55 percent for nonmovers, 64 percent for in-movers). This may be a consequence of a greater proportion of NRFU-proxy cases having insufficient data for matching. For example, a proxy respondent (such as a neighbor) may only be able to provide limited information about a housing unit, such as the population count and some demographic information. If the proxy respondent was unable or unwilling to provide the names of

the persons living in the unit, then the census records would have insufficient information for the CCM matching. The results do suggest that proxy responses are potentially problematic, as proxies may not provide complete and accurate information for the census enumeration.

Similarly, young children associated with households determined to be vacant or delete in the Census have very high nonmatch rates (73 percent for nonmovers and 86 percent for inmovers). The fact that this nonmatch rate is not 100 percent displays the limitation of this analysis, as discussed previously. In these P-sample housing units that matched to a vacant or delete census housing unit, there are some P-sample young children that do match to a census enumeration. These matches must be to a different census housing unit in the search area. Therefore, these results are not a perfect method of determining what happened in the census to result in the young child nonmatch. However, the stark difference between the nonmatch rates for household respondents (self response or NRFU) versus proxy respondents (occupied or vacant/delete) suggests that unknowledgeable or unwilling proxy respondents may be a key factor in the undercount of young children.

Inmover young children associated with NRFU households with a household respondent have a nonmatch rate of 20 percent, much higher than the NRFU household respondent rate for nonmovers. This likely speaks to the role of mobility in contributing to enumeration errors.

Table 13. Nonmatch Rates - Mode of Enumeration

	Nonmatch Rate	
	Weighted Estimate	Standard Error
Nonmover	8.2	0.3
Self response	3.7	0.2
NRFU – Household respondent and Update/Enumerate	8.9	0.6
NRFU – Proxy respondent, occupied	54.7	2.3
NRFU – Vacant/delete	73.4	3.8
Inmover	18.9	1.2
Self response	8.5	1.0
NRFU – Household respondent and Update/Enumerate	20.2	2.4
NRFU – Proxy respondent, occupied	63.9	5.4
NRFU – Vacant/delete	86.3	5.9

Source: 2010 Census Coverage Measurement – Special Tabulation

6. CONCLUSIONS

Studying CCM nonmatches as a surrogate for true census omissions has important limitations. Nonetheless, the results of this analysis provide useful information for understanding instances where the census count of young children was not complete and accurate. The following findings warrant consideration:

- **Young children were often nonmatches along with other family members.** About 46 percent of the nonmatched young children in this study were in a household where all persons were nonmatches. Another 22 percent were in households where at least one other household member was a nonmatch. While these may be instances where the nonmatch was due to the census records having insufficient information for matching, these results

suggest that both within-household and whole-household errors contribute to the undercount of young children.

- **Frame errors may contribute to this undercoverage.** While 84 percent of all nonmatching children had a matching housing unit, 16 percent of young children identified as nonmatches were in a housing unit that did not match to the census. These nonmatching housing units may represent frame errors in the census, but the limitations of the CCM data prevent us from concluding this for certain.
- **Some demographic characteristics have high risks of potential omissions.** Children who were grandchildren, other relatives (such as a niece, nephew, or cousin), and nonrelatives of the householder had some of the highest nonmatch rates. This may indicate rostering errors for children who have these relationships to the household. Black, American Indian and Alaska Native, and Some Other Race young children had higher nonmatch rates than White young children.
- **Household characteristics known to be associated with coverage error for the adult population appear to hold for young children.** Children who were in-movers and children living in renter-occupied units had high nonmatch rates. Mobility may add to the risk of undercoverage of young children. This is especially true if a unit must be enumerated by a proxy during NRFU because the Census Day residents of the unit no longer lived there. Children living in nonrelated households had high nonmatch rates, as did children of young householders.
- **NRFU proxy respondents and misclassification of vacant units may contribute to the undercount of young children.** Young children associated with a census housing unit that required a NRFU proxy response had a very high likelihood of omission. Misclassification of occupied units as vacant or delete during the census appears to be another major source of enumeration error.
- **Households that fit the description of being “easier-to-enumerate” still include errors that add substantially to this undercount problem.** Despite having some of the lowest nonmatch rates, the characteristics that involve the majority of nonmatches include White children, non-Hispanic children, biological children, and nonmovers. We will not resolve the undercount of young children without addressing these populations.

7. NEXT STEPS

In the course of producing the data for this report we identified several additional tabulations and cross-tabulations that we think will help us to better understand the characteristics of census omissions. Specifically, we suggest the following additional research:

- Examine the characteristics of the missed housing units that resulted in a missed young child. It would be useful to know if these housing units look like all other missed housing units or if they have any unique properties.
- Sample permitting, create cross-tabulations of the nonmatch rates to gain greater insights into the possible reasons for certain nonmatches. For example, when the child was the only nonmatch in a household, how was that child related to the householder? Are biological children nonmatches when the entire household is a nonmatch?
- To help us better understand the proportion of in-mover nonmatches that were children counted in the census but at the wrong address, try to link nonmatches to E-sample erroneous enumerations.
- Explore other methods to understand the role of insufficient data in distorting the nonmatch rates. Look at the imputation status of specific cases, like the whole-household nonmatches.
- Examine the number of young children that have unresolved match statuses to help understand the potential limitations of some of our findings.

8. REFERENCES

Contreras, G., Cronkite, D., Rosenberger, L., Wakim, A., and Henderson, K. (2012). Assessment for the 2010 Census Coverage Measurement Final Housing Unit Matching and Followup Operations. 2010 Census Planning Memoranda Series No. 219. Retrieved from http://www.census.gov/2010census/pdf/2010_Census_CCM_FHU_Matching_Followup_Assessment.pdf

Hogan, H. (1993). The 1990 Post-Enumeration Survey: Operations and Results. *Journal of the American Statistical Association*, Volume 88, Issue 423 (Sept. 1993), 1047-1060.

Hogan, H., Cantwell, P., Devine, J., Mule, V., and Velkoff, V. (2013). Quality and the 2010 Census. *Population Research and Policy Review*, DOI 10.1007/s11113-013-9278-5.

Johnson, S., Sanchez, P., Wakim, A., and Henderson, K. (2012). 2010 Census Coverage Measurement Person Matching and Followup Operations Assessment Report. 2010 Census Planning Memoranda Series No. 242. Retrieved from http://www.census.gov/2010census/pdf/2010_Census_CCM_PMF_Assessment.pdf

Linse, K. and Argarin, A.C. (2012). 2010 Census Coverage Measurement Person Interview Operation Assessment. 2010 Census Planning Memoranda Series No. 208. Retrieved from http://www.census.gov/2010census/pdf/2010_Census_CCM_PI_Assessment.pdf

Moldoff, M. (2008). The Design of the Coverage Measurement Program for the 2010 Census. DSSD 2010 Census Coverage Measurement Memorandum Series #2010-B-07. Retrieved from https://www.census.gov/covrage_measurement/pdfs/2010-B-07.pdf

Mule, T. (2012). 2010 Census Coverage Measurement Estimation Report: Summary of Estimates of Coverage for Persons in the United States. DSSD 2010 Census Coverage Measurement Memorandum Series #2010-G-01. Retrieved from https://www.census.gov/coverage_measurement/pdfs/g01.pdf

O'Hare, W. (2015). The Undercount of Young Children in the U.S. Decennial Census. Springer Briefs in Population Studies.

O'Hare, W. P., and Jensen, E. B. (2014). The Representation of Young Children in the American Community Survey, presentation at the ACS Users Group Conference, Washington, DC. May 29-30. Retrieved from https://acsdatacommunity.prb.org/p/2014_acs_conference

Robinson, J. G., and Adlakha, A. (2002). Comparison of A.C.E. Revision II Results with Demographic Analysis. DSSD A.C.E. Revision II Memorandum Series #PP-41. Retrieved from <https://www.census.gov/dmd/www/pdf/pp-41r.pdf>

Fenstermaker, D. (2002) A.C.E. Revision II: Summary of Estimated Net Coverage. DSSD A.C.E. Revision II Memorandum Series #PP-54. Retrieved from <https://www.census.gov/dmd/www/pdf/pp-54r.pdf>

U.S. Census Bureau. (2011). Age and Sex Composition: 2010. 2010 Census Briefs. Retrieved from <http://www.census.gov/prod/cen2010/briefs/c2010br-03.pdf>

U.S. Census Bureau. (2014). Final Task Force Report on the Undercount of Young Children. Retrieved from <http://www.census.gov/content/dam/Census/library/working-papers/2014/demo/2014-undercount-children.pdf>

Viehdorfer, C., Seiss, M., and Diffendal, G. (2012). 2010 Census Coverage Measurement Estimation Report: Missing Data for Net Coverage Estimation. DSSD 2010 Census Coverage Measurement Memorandum Series #2010-G-08. Retrieved from https://www.census.gov/coverage_measurement/pdfs/g08.pdf

West, K., and Robinson, J.G., (1999). What Do We Know about the Undercount of Children? U.S. Census Bureau, Population Division working paper. Retrieved from <http://www.census.gov/library/working-papers/1999/demo/POP-twps0039.html>